**COLLOQUIUM**

Department of Computer Science and Engineering

University of South Carolina

**Active Subspace and Surrogate Model Techniques for Complex Physical and Biological Models**

**Ralph Smith**

**North Carolina State University**

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# Abstract

For many complex physical and biological models, the computational cost of high-fidelity simulation codes precludes their direct use for Bayesian model calibration and uncertainty propagation. Furthermore, the models often have tens to thousands of inputs--comprised of parameters, initial conditions, or boundary conditions--many of which are unidentifiable in the sense that they cannot be uniquely determined using measured responses. In this presentation, we will discuss techniques to isolate influential inputs and employ surrogate models when computational budgets are limited. For input selection, we will discuss the use of global sensitivity analysis methods to isolate influential inputs and active subspace construction for linearly related parameters. We will also discuss the manner in which Bayesian calibration on active subspaces can be used to quantify uncertainties in physical parameters. These techniques will be illustrated for models arising in nuclear power plant design and HIV characterization and treatment.

**Ralph Smith** received his PhD in Applied Mathematics from Montana State University in 1990. Following a three-year postdoctoral position at the Institute for Computer Applications in Science and Engineering (ICASE) at NASA Langley Research Center, he was an Assistant Professor in the Department of Mathematics at Iowa State University. He joined the North Carolina State University faculty in 1998, where he is presently a Distinguished Professor of Mathematics. He is Editor-in-Chief of the SIAM book series on Advances in Design and Control and is on the editorial boards of the SIAM/ASA Journal on Uncertainty Quantification and the Journal of Intelligent Material Systems and Structures. He is co-author of the research monograph Smart Material Structures: Modeling, Estimation and Control and author of the books Smart Material Systems: Model Development and Uncertainty Quantification: Theory, Implementation, and Applications. His research areas include mathematical modeling of smart material systems, numerical analysis and methods for physical systems, Bayesian model calibration, sensitivity analysis, control, and uncertainty quantification.